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FOREST PEST MANAGEMENT

LARCH NEEDLE CAST SURVEY, SUMMER 1981

Prepared by:

KATHRYN ROBBINS, Pathologist
St. Paul, Minn. Field Office

INTRODUCTION

A needle cast disease was recently reported on European larch (Larix decidua) growing in northeastern Iowa and southwestern Wisconsin. Mycosphaerella laricina, a fungus native to Europe and not previously known to occur in the United States, was identified as the cause (Patton, 1981).

The symptoms of larch needle cast first appear in early summer as yellow spots on needles of lower branches. With time, these spots enlarge and turn brown. Additional needles located higher in the crown become infected and many are cast prematurely. Black fruiting bodies (pycnidia) form in the brown spots, often while the needles are still attached to the tree. The life cycle of the causal fungus (Figure 1) was described by Hartig (1895).

Because of their rapid growth, exotic larches show promise as a source of pulp and lumber in this country. A disease such as this needle cast may prevent larches from attaining their potential growth. Before exotic larches are extensively planted in the Lake States, knowledge of the distribution and impact of this disease and other larch pests should be obtained.

Three groups are currently working on the needle cast:

1. Pathologists at the North Central Forest Experiment Station, in cooperation with the Wisconsin DNR and the Iowa

Conservation Commission, are studying the biology and control of the causal fungus and phenology of the host and disease in three European larch plantations.

2. Dr. Robert Patton, Dept. of Plant Pathology, University of Wisconsin, is investigating the taxonomy and cultural characteristics of the causal fungus.

3. State & Private Forestry personnel are determining the distribution and severity of the disease in the Lake States and Iowa.

OBJECTIVES

This survey attempted to determine the geographic location and extent of infection, and to assess the influence of site and stand characteristics on Mycosphaerella needle cast of larch.

A secondary objective of the survey was to record the presence of other diseases and insects injurying larch.

METHODS

Stands of larch where the needle cast had been previously observed were surveyed. Additional stands, found by contacting State Forestry agencies, were visited in Iowa, Michigan, and Wisconsin.

Location, tree species, seed source, year planted, size, aspect, percent slope, and presence or absence of needle cast was recorded for each stand. Presence of the disease was confirmed by obtaining characteristic conidia of Mycosphaerella laricina from pycnidia produced on infected needles.

Several infected stands in Wisconsin were intensively surveyed to determine the pattern of disease distribution within the stands. Every fifth row of larches running across the slope was examined beginning at the upper edge row. The following information was recorded: tree diameter (D.B.H.), position on slope (upper, middle, or lower), position in stand (edge or interior), crown closure, and needle cast severity. The severity of needle cast was based on a modification of the 6-class dwarf mistletoe system (Hawksworth 1977):

1. Live crown was divided into thirds,

2. Each third was rated separately and each was given a rating of either 0,1, or 2 as described below:

   (0) No visible needle cast symptoms

   (1) Light needle cast (1/2 or less of total number of branches affected)

   (2) Severe needle cast (more than 1/2 of total number of branches affected)

3. Finally, ratings of thirds were added to obtain a rating for the total tree, which could range from 0 to 6.

RESULTS

Sixty-three stands of larch were examined for symptoms of Mycosphaerella needle cast. The disease was confirmed in 28 of 42 stands of European larch and in 2 of 4 stands of hybrid larch (L. x eurolepis). None of the 14 Japanese larch (L. leptolepis) stands or the 2 tamarack (L. laricina) stands surveyed showed symptoms of the needle cast (Table 1). In the mixed stand of larch (No. 23), only the European larch showed signs of the disease; the hybrid and Japanese larches were not affected.

Severity of the disease varied with seed source of European larch. Larch from Alpine sources (Austrian, French, and Italian) were quite susceptible while those from provenances farther north in Europe (Czech and Polish) were less susceptible. In the two areas where hybrid and European larch were growing together and the disease was present, hybrid larches were more resistant than the European larches. Larches of the more resistant seed sources were larger (Table 2).

Needle cast severity was not related to age, size, aspect, or percent slope of the stand. It was also not related to crown closure, slope position or stand position of individual trees within an infected stand. Disease severity was correlated with location in crown (Table 3) and tree diameter (Table 4).

Many other pests were found in the larch stands examined (Table 1). The most common of these was larch sawfly (Pristiphora erichsonii). This defoliator seemed to show a feeding preference for Japanese over European larch. Other insect pests observed were the larch casebearer (Coleophora laricella), a wooly aphid (Adelges strobilobius), a needle tier (Paralobesia palliolana), forest tent caterpillar (Malacosoma disstria), and a terminal weevil (possibly Pissodes strobi). Other types of damage included dead tops, windthrow, frost injury, lightning strikes, feeding by deer, porcupines, and squirrels, ice storm breakage, snow bending, and shoot blight. An unidentified species of Phomopsis was isolated from larch twigs with shoot blight, but pathogenicity tests of this fungus have not been conducted.

A stand of European larch (No. 22) where cankers caused by Lachnellula willkommii had been reported (Baxter 1967) was examined. Stem cankers were found on trees in this stand and in another (No. 24) a few miles away, but the cause of these cankers has not yet been confirmed.

DISCUSSION

Mycosphaerella needle cast of larch was found in five separate areas in the Upper Midwest. The disease was later found in two other European larch stands in Wisconsin, one in Polk County and one in Grant County 1/(Figure 2). The occurrence of this disease in isolated larch

stands hundreds of miles apart suggests that the causal fungus was spread on infected nursery stock. The discovery this summer of seedlings of European larch infected with Mycosphaerella laricina growing in a nursery[1]/ provides additional evidence that spread may have occurred in this way.

The hybrid larches examined were very resistant and Japanese larch appears to be immune to this disease. Tamarack was not growing near known sources of inoculum, so its relative susceptibility is not known.

The consistently higher needle cast ratings for the lower third of the crowns of infected larch supports Hartig's (1895) description of spread of the causal fungus in the spring from cast needles on the ground to newly emerged needles on lower branches (Figure 1). The disease develops higher in the crown as summer progresses.

Because symptoms develop quite late in the growing season on resistant trees and in susceptible stands with light infections, surveys for this needle cast should be done in late August or early September. Severity ratings increase during the summer as secondary infections increase. Consequently, ratings made in different stands at different times of the year are not comparable.

The impact on growth of trees with needle cast appears to be severe (Table 2 and 4), but growth differences may also have been influenced by other pests and genetic growth characteristics. Assessing the impact of the disease on growth would require correlating needle cast severity with growth over several years. Before this disease was identified, larch sawfly and larch casebearer were considered the major pests of larch in the United States. Chemical controls of these insects may be warranted if defoliation occurs over several successive years. Populations of small mammals, such as shrews and voles, should be encouraged in sawfly-infested stands because they destroy many sawfly cocoons that overwinter in the litter.

Spring frost injury, another important problem of larch, can be avoided by not planting larch in frost pockets and by selecting seed sources that flush relatively late.

In addition to gathering information on pests of larch, the occurrence of a possibly beneficial organism was noted during this survey. Suillus grevillei, a large yellow bolete mushroom, was found growing in all the larch stands on the Yellow River State Forest near Waterville, Iowa and in several stands on the Coulee Experimental Forest near Bangor, Wisconsin. This fungus forms mycorrhizae in association with larch roots (Trappe 1962), thereby improving the trees' water and mineral uptake. It might be possible to use this organism in the production of nursery and container-grown larch seedlings to improve their growth and survival following outplanting.

RECOMMENDATIONS

1. In areas where Mycosphaerella needle cast has been confirmed,

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[1]/ Personal communication, Allen Prey, Forest Pathologist, Wisconsin Department of Natural Resources, Madison.

either resistant hybrid or Japanese larch should be planted instead of additional European larch.

2. If the needle cast is not present, fast growing, disease-resistant seed sources of European larch (e.g., Polish and Czech) could also be considered for planting.

3. European larch seedlings growing in nurseries should be carefully monitored for this disease to avoid out-planting infected stock. Larch trees growing in and around nurseries producing larch seedlings should be removed.

4. Susceptibility of tamarack to this needle cast should be determined.

5. Controls for infected larch stands and nursery beds should be developed.

6. Records of seed source (including elevation), outplanting survival, growth, and injury by pests should be maintained for all larch plantations by the agencies that establish them.

ACKNOWLEDGMENTS

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Figure 1. Life Cycle of Larch Needle Cast Caused by Mycosphaerella laricina (based on Hartig 1895).

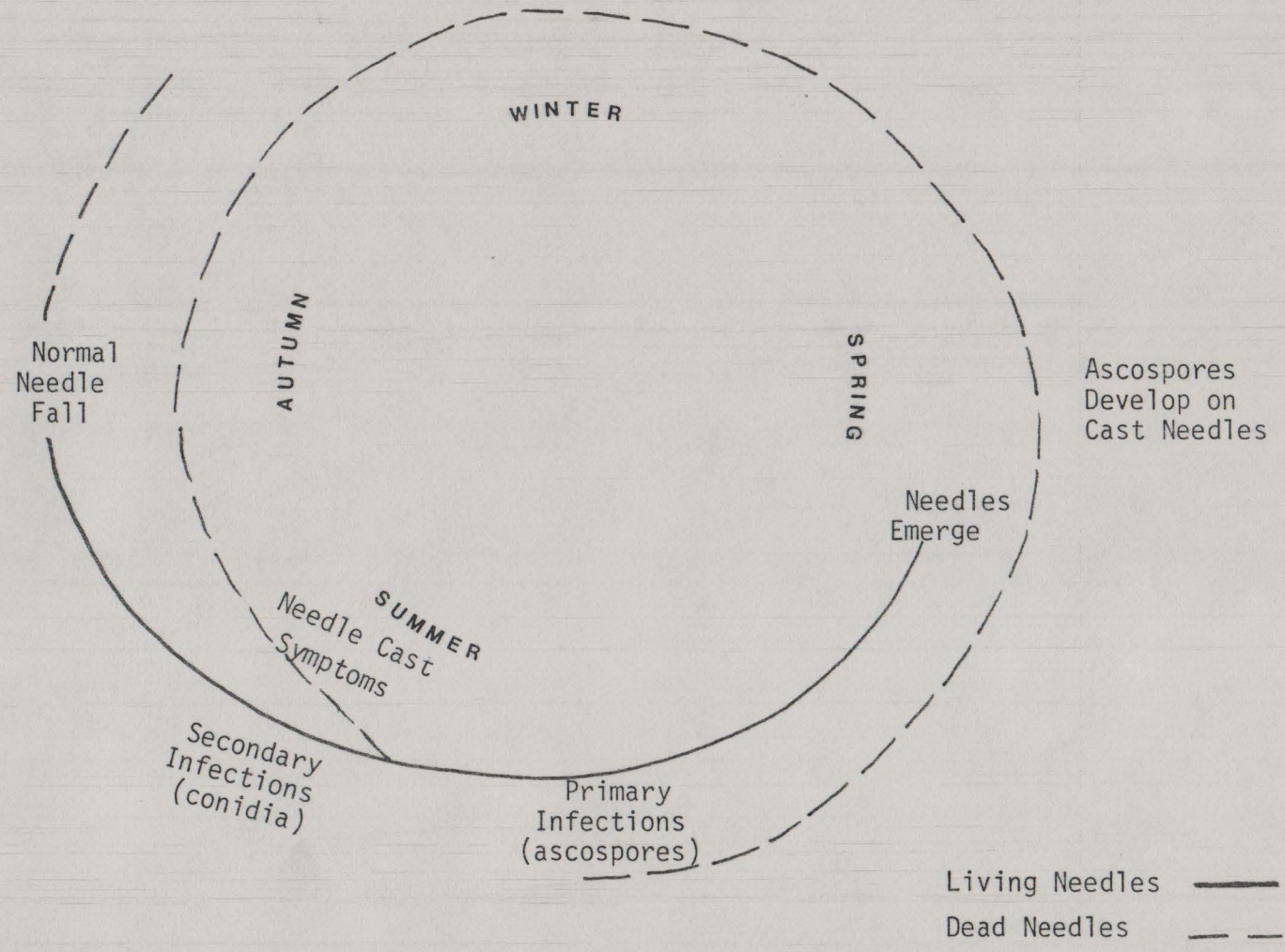

Figure 2. Locations (▲) of European Larch Stands with Mycosphaerella Needle Cast - 1981.

Table 1.--Larch stands surveyed for Mycosphaerella needle cast and other pests.

Stand No.	Location	Species[a]	Seed Source	Year Planted	Size (ha)	Aspect	Slope (%)	Needle Cast	Other pests or Damage[b]
1	Unionville, IA	E	Polish	1960	<1	S	3	None	S, F
2	Unionville, IA	E	----	1961	<1	NA[c]	0	None	S
3	Unionville, IA	H	----	1961	<1	NA	0	None	S
4	Ash Grove, IA	E	----	1960	<1	E	20	None	S
5	Ash Grove, IA	E	----	1957	<1	N	20	None	S, WT
6	Ash Grove, IA	H	----	1961	<1	NA	0	None	S
7	Ash Grove, IA	J	----	1961	<1	NE	15	None	S, WT
8	Ash Grove, IA	E	----	1959	<1	NA	0	None	S, LS
9	Solon Springs, WI	E	----	1971	<1	NA	0	None	C, FTC, F, P, D, SQ
10	Balsam Lake, WI	E	----	1971	4	NA	0	Moderate	TW, F, SB
11	Rose Lake, MI	J	----	1960	<1	NA	0	None	S, C, WA, NT
12	Augusta, MI	J	----	1961	<1	NA	0	None	S, C, WA
13	Augusta, MI	J	----	1960	<1	NA	0	None	S
14	Augusta, MI	E	----	1938	<1	NW	20	None	S
15	Augusta, MI	E	----	1938	<1	SW	10	None	S, I
16	Augusta, MI	T	----	1968	<1	SW	5	None	S, C
17	Augusta, MI	E	----	1936	<1	NA	0	None	S, WA
18	Decatur, MI	J	----	1961	<1	NA	0	None	SNB
19	Decatur, MI	J	----	1960	<1	NA	0	None	SB
20	Decatur, MI	T	----	1967	<1	NA	0	None	SB
21	Decatur, MI	J	----	1961	<1	NA	0	None	S, SB
22	Dexter, MI	E	----	1949	<1	NE	2	None	LC (?), S, C
23	Dexter, MI	E,J,H	----	1960	1.5	NA	0	Light (E only)	C, S
24	Dexter, MI	E	----	1961	<1	NA	0	None	LC (?), S, C

Table 1.--(continued)

Stand No.	Location	Species[a/]	Seed Source	Year Planted	Size (ha)	Aspect	Slope (%)	Needle Cast	Other Pests or Damage[b/]
25	Waterville, IA	E	Polish	1959	<1	E	10	Light	---
26	Waterville, IA	E	French	1959	<1	E	10	Heavy	DT, SB
27	Waterville, IA	E	Polish	1958	<1	E	10	Light	S
28	Waterville, IA	E	Austrian	1958	<1	E	10	Moderate	---
29	Waterville, IA	E	Austrian	1958	<1	E	10	Moderate	---
30	Waterville, IA	H	----	1958	<1	E	10	Very Light	S, SB
31	Waterville, IA	E	Austrian	1958	<1	SW	8	Moderate	---
32	Waterville, IA	E	Austrian	1958	<1	SW	8	Moderate	S
33	Waterville, IA	E	Polish	1958	<1	SW	8	Light	S, SB
34	Waterville, IA	E	Polish	1959	<1	SW	5	Light	S
35	Waterville, IA	E	French	1959	<1	SW	5	Heavy	DT, SB
36	Waterville, IA	H	----	1960	<1	SW	3	Very Light	S, SB
37	Waterville, IA	J	----	1960	<1	SW	3	None	S
38	Waterville, IA	J	----	1949	<1	S	15	None	S
39	Waterville, IA	E	Austrian	1949	<1	S	15	Light	SB
40	Waterville, IA	J	----	1949	<1	S	10	None	S
41	Waterville, IA	J	----	1949	<1	W	10	None	S
42	Waterville, IA	E	Austrian	1949	<1	W	10	Light	S, SB
43	Waterville, IA	E	Austrian	1949	<1	S	5	Light	SB
44	Waterville, IA	J	----	1949	<1	NE	15	None	S
45	Waterville, IA	E	----	1949	<1	NE	10	Moderate	S
46	Waterville, IA	J	----	1949	<1	NE	10	None	S
47	Greely, IA	E	----	1965	3.2	S	3	None	NT, C, S
48	Dubuque, IA	E	----	1963	<1	NA	0	Very Light	S

Table 1.--(continued)

Stand No.	Location	Species[a/]	Seed Source	Year Planted	Size (ha)	Aspect	Slope (%)	Needle Cast	Other Pests or Damage[b/]
49	Independence, WI	E	Austrian	1968	1	SW	15	Heavy	S, SB, F
50	Independence, WI	E	Austrian	1968	1	NE	25	Heavy	DT
51	Bangor, WI	E	----	1966	<1	N	20	Heavy	---
52	Bangor, WI	E	Austrian	1962	<1	N	3	Light	---
53	Bangor, WI	E	Austrian	1962	<1	NW	15	Light	---
54	Bangor, WI	E	Austrian	1962	<1	NW	10	Light	---
55	Bangor, WI	E	Austrian	1962	<1	NW	2	None	S
56	Bangor, WI	E	Austrian	1962	<1	NA	0	None	S
57	Bangor, WI	E	----	1976	<1	SE	3	Very Light	---
58	Bangor, WI	E	----	1979	<1	S	3	Very Light	---
59	Bangor, WI	E	Austrian	1962	<1	E	10	Very Light	---
60	Bangor, WI	E	Austrian	1962	<1	N	25	Very Light	---
61	Bangor, WI	E	----	1966	<1	S	15	Moderate	---
62	Bangor, WI	E	----	1966	<1	SW	10	Moderate	---
63	Waterville, IA	J	---	?	<1	SE	5	None	S

a/ E = European Larch, H = Hybrid Larch, J = Japanese Larch, and T = Tamarack.

b/ C = Casebearer, D = Deer Browsing, DT = Dead Tops, F = Frost Damage, FTC = Forest Tent Caterpillar, I = Ice Storm Damage, LC = Larch Canker, LS = Lightning Strike, NT = Needle Tier, P = Porcupine Feeding, S = Sawfly, SB = Shoot Blight, SNB = Snow Bending, SQ = Squirrel Feeding, TW = Terminal Weevil, WA = Wooly Aphid, WT = Wind Throw.

c/ NA = Not Applicable

Table 2.--Growth[a/] and needle cast severity in larch plantings established in 1958-1960 on the Yellow River State Forest near Waterville, Iowa.

Species	Seed Source	Survival (%)	Dbh (in.)	Basal Area (sq. ft.)	Height[b/] (ft.)	Volume		Needle Cast[c/]
						Total (cu. ft)	Merchantable (cu. ft.)	
E	France	15	2.0	4	17	---	---	Heavy
E	Austria	10	6.0	23	43	350	300	Moderate
E	Austria	25	5.5	50	40	850	700	Moderate
E	Poland	64	6.2	159	54	3,700	3,300	Light
E	Poland	53	6.4	145	55	3,250	2,900	Light
H	(hybrid)	68	5.8	165	53	3,550	3,050	Very Light
J	Many	77	7.4	153	57	3,350	3,100	None

[a/] Unpublished growth data, measured in spring and summer 1980, supplied by R. Jacobs and J. Shafer, Foresters, USDA Forest Service, NA S&PF, St. Paul, MN.
[b/] Height: dominants and codominants.
[c/] Needle cast evaluated in summer 1981.

Table 3.--Results of surveys of four European larch stands in Wisconsin with Mycosphaerella needle cast.

Stand No.[a/]	Number of Trees Sampled	Average D.B.H. (inches)	Average Needle Cast Severity[b/]			
			Lower 1/3	Mid 1/3	Top 1/3	Total
49	66	5.6	1.9	1.4	0.6	3.9
50	157	3.0	2.0	1.8	1.4	5.2
51	85	4.4	1.8	1.4	0.5	3.7
61	46	5.1	1.7	1.3	0.4	3.4

[a/] Stand numbers correspond to those in Table 1.
[b/] Needle cast severity based on rating each 1/3 of the living crown (0 = no visible cast; - = 1/2 or less of branches with cast; 2 = more than 1/2 of branches with cast) and then adding rating for each 1/3 to determine the total severity rating. Stands rated during mid-August, 1981.

Table 4.--Needle cast severity [a/] of trees in three diameter size classes in four European larch stands in Wisconsin.

Stand No. [b/]	Number of Trees Sampled	Diameter Size Class		
		4.0 (in.)	4.1-6.0 (in.)	6.1 (in.)
49	66	4.7	4.1	3.4
50	157	5.5	4.4	3.2
51	85	4.4	3.2	3.0
61	46	3.9	3.1	3.2
Mean		4.6	3.7	3.2

[a/] Tree crowns divided into thirds and rated separately: 0 = no needle cast; 1 = light needle cast; 2 = severe needle cast; ratings for each third are added to obtain rating for the total tree. Trees rated in mid-August, 1981.
[b/] Stand numbers correspond to those in Table 1.